

## Chi-Square HW

NAME: Key

Perform FULL tests of significance on each problem. (Be sure to state and check assumptions as well as write a full conclusion)

### Chi-Square Goodness of Fit

1. Suppose you are given a homework assignment to test the fairness of a certain die. You are asked to roll the die 6000 times and to note how often it comes up 1, 2, 3, 4, 5, or 6. Being careful to make the total 6000, you get the following results for the numbers 1-6 (respectively): 994, 1016, 950, 1020, 1012, and 1008. Is the die fair?

State      Check

- 8KS
- all expected counts  $\geq 5$
- assumed
- all exp. counts = 1000  $\checkmark$  5

die :	1	2	3	4	5	6
Exp :	1000	1000	1000	1000	1000	1000
Obs :	994	1016	950	1020	1012	1008

$H_0$ : the observed frequency distribution of rolls of the dice fits the expected distribution.

$H_a$ : the obs. freq. distr. of rolls of dice does not fit the expected distribution.

$$\chi^2 = \sum \frac{(\text{obs} - \text{exp})^2}{\text{exp}} = \frac{(994 - 1000)^2}{1000} + \frac{(1016 - 1000)^2}{1000} + \dots = 3.4$$

$$P(\chi^2 > 3.4 / df = 5) = 0.6386$$

— We fail to reject  $H_0$  b/c p-value of 0.6386 >  $\alpha = 0.05$ .

— We have sufficient evidence that the observed frequency distribution of rolls of the die fits the expected distribution. The die is fair.

### Chi-Square Test for Association

2. A medical researcher tests 640 heart attack victims for the presence of a certain antibody in their blood and cross-classifies against the severity of the attack. The results are reported in the following table:

	Severe	Medium	Mild
Positive test	85	125	150
Negative test	40	95	145

Is there evidence of a relationship between presence of the antibody and severity of the heart attack? Test at the 5% significance level.

State

- 2 independent SRS
- all expected counts  $\geq 5$

Check

- assumed
- all exp counts  $\geq 5$

$H_0$ : there is no association between severity of heart attack & result of test (they are independent)

$H_a$ : there is an association between severity of heart attack and result of test (they are dependent)

$$\chi^2 = \sum \frac{(\text{obs} - \text{exp})^2}{\text{exp}} = \frac{(85 - 70.313)^2}{70.313} + \frac{(125 - 123.75)^2}{123.75} + \dots = 10.54$$

$$P(\chi^2 > 10.54 / df = 2) = 0.00514$$

- We reject  $H_0$  b/c p-value of  $0.00514 < \alpha = 0.05$ .
- We have sufficient evidence that there is an association between severity of heart attack & result on test.